

**Traumatic Brain Injury in Hawaii, 1996-98:  
A descriptive report of hospital admissions.**

Injury Prevention and Control Program,  
Hawaii Department of Health

The data for this report come from the Hawaii Health Information Corporation (HHIC), which receives patient information from all acute care facilities in the state. Traumatic brain injury (TBI) was defined by the following diagnostic codes, as defined in the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM). (Up to ten ICD-9 diagnosis codes were considered for each patient for the classification of TBI.)

800.0-801.9    fracture of the vault or base of the skull  
803.0-804.9    other and unqualified and multiple fractures of the skull  
850.0-854.1    intracranial injury, including concussion, contusion, laceration, and hemorrhage.

The following report describes the age, gender, and county of residence of TBI patients, as well as the length and cost of their hospitalization, and their ultimate disposition. Finally, the cause of the injury, as noted by the external cause codes (or E-codes), is also described. Since E-coding is not universal among contributing hospitals, however, this information was available for only 42% of the TBI admissions. In particular, this information was not available for patients treated at the Queen's Medical Center on Oahu, so the resulting information on cause of TBI should be interpreted with caution. Nonetheless, further analyses were conducted to describe patient characteristics within the major E-code categories.

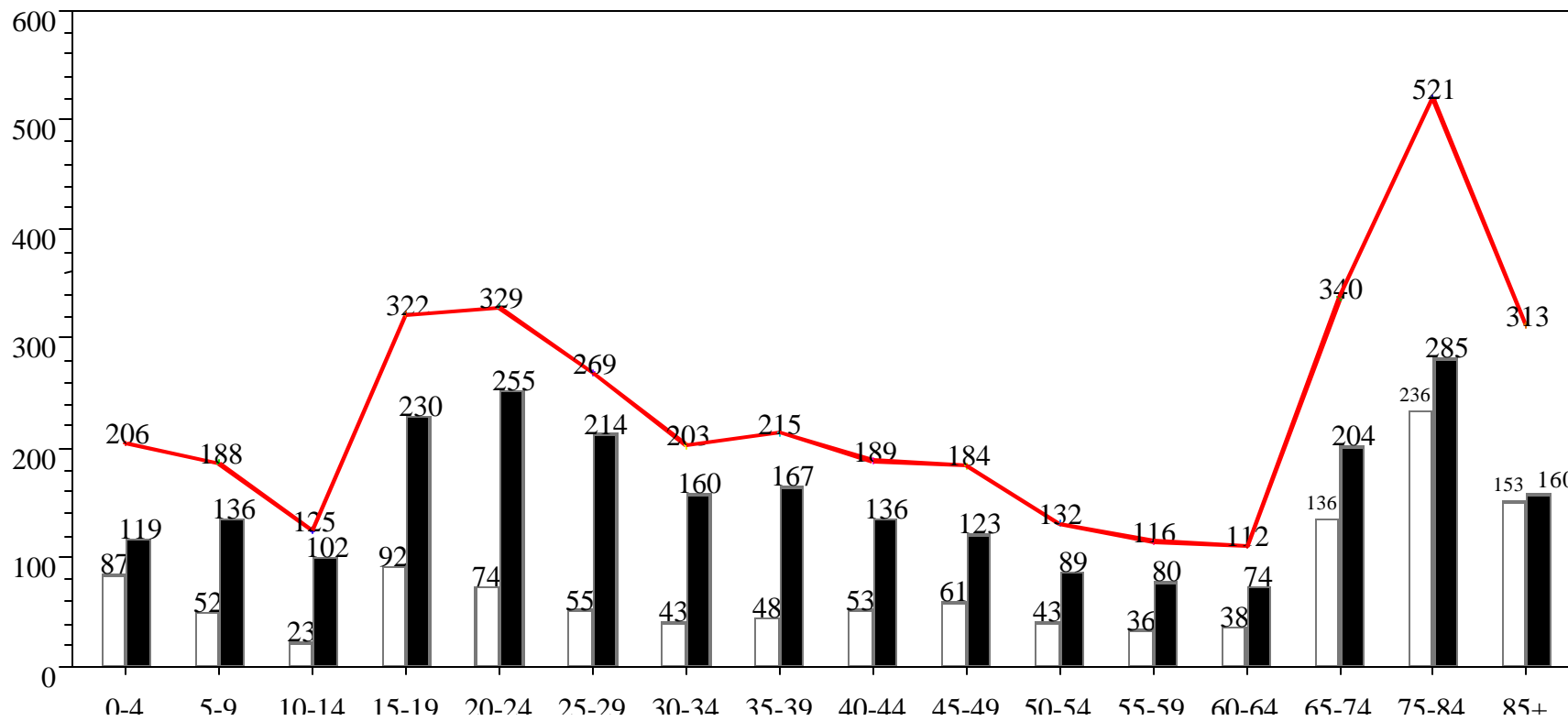
There were 3,764 total admissions for TBI over the 3-year period. The table below summarizes different types of TBI, based on ICD-9 codes.

**Types of TBI treated in Hawaii hospitals, 1996-98.**

TBI type	Number of patients	Percent of patients
concussion only	915	24
skull fracture only	775	21
other intracranial injuries, w/o skull fracture	168	4
other intracranial injuries, w/skull fracture	1,906	51
total	3,764	

### Number of TBI admissions in Hawaii hospitals, by age and gender, 1996-98.

(White bars represent admissions among females, black bars admissions among males, and solid line total for both genders.)



\*Approximately two-thirds of the 3,764 patients (1,735) were male.

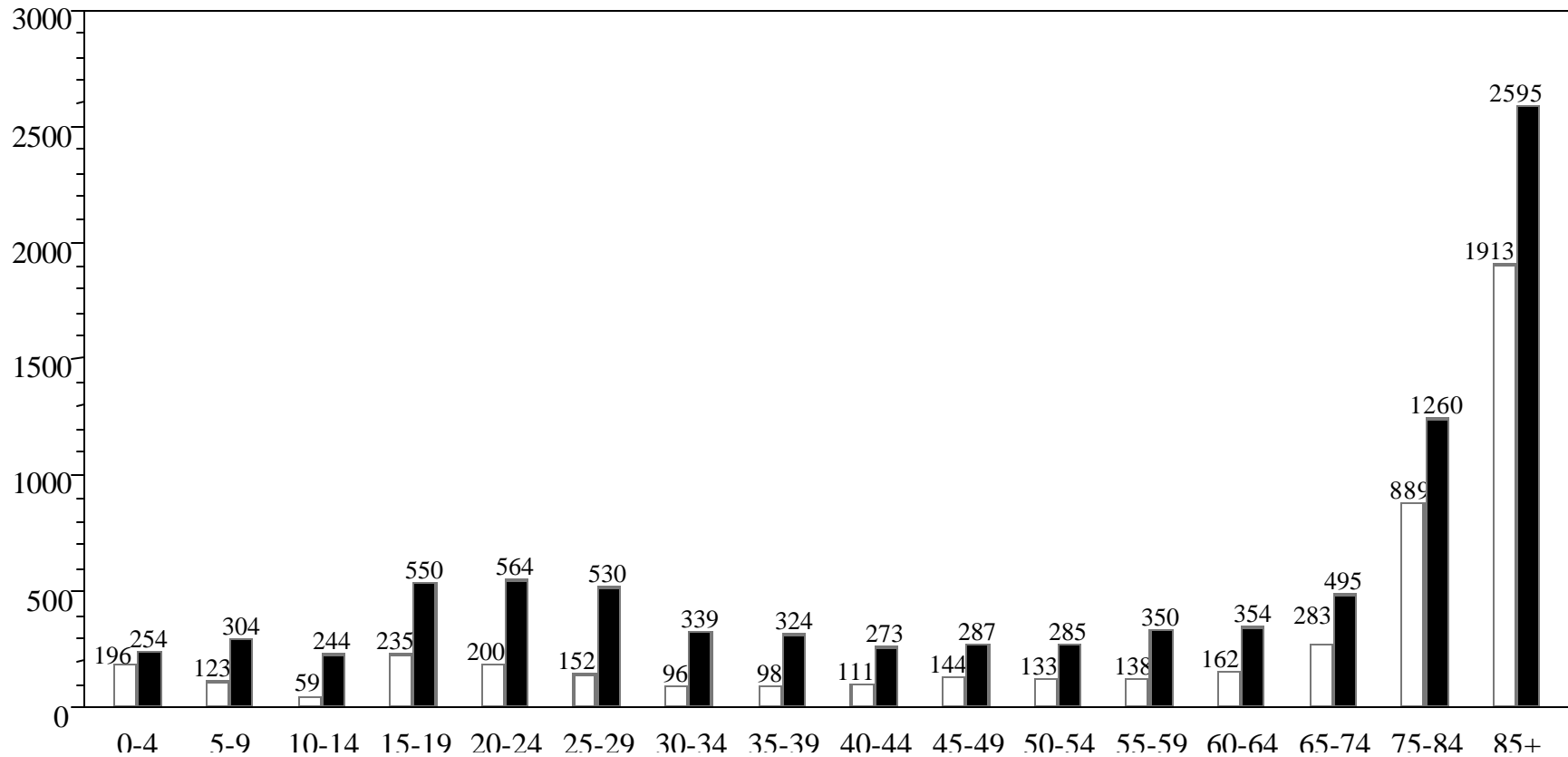
\*There were two noticeable peaks in the age distribution of the victims: from approximately ages 15-29 years and age 65 and older.

\*Admissions among males were generally at least double those among females at all age groups except the youngest (0-4 year-olds) and oldest groups (ages 75 or older).

\*The high number of admissions among the elderly translated into extremely high rates of hospitalization among those 75 years or older, particularly among males.

## Rate<sup>#</sup> of hospital admissions for TBI in Hawaii, by age and gender, 1996-98.

(White bars represent admission rate among females, black bars admission rate among males.)



<sup>#</sup> Rate is per 100,000 residents, as estimated in 1996.

\*Rate estimates generally paralleled the total number of TBI admissions, with peak rates among 15-29 year-olds and those aged 75 years and older. The low population of elderly translated into extremely high rates of hospitalization among those 75 years or older, particularly among males.

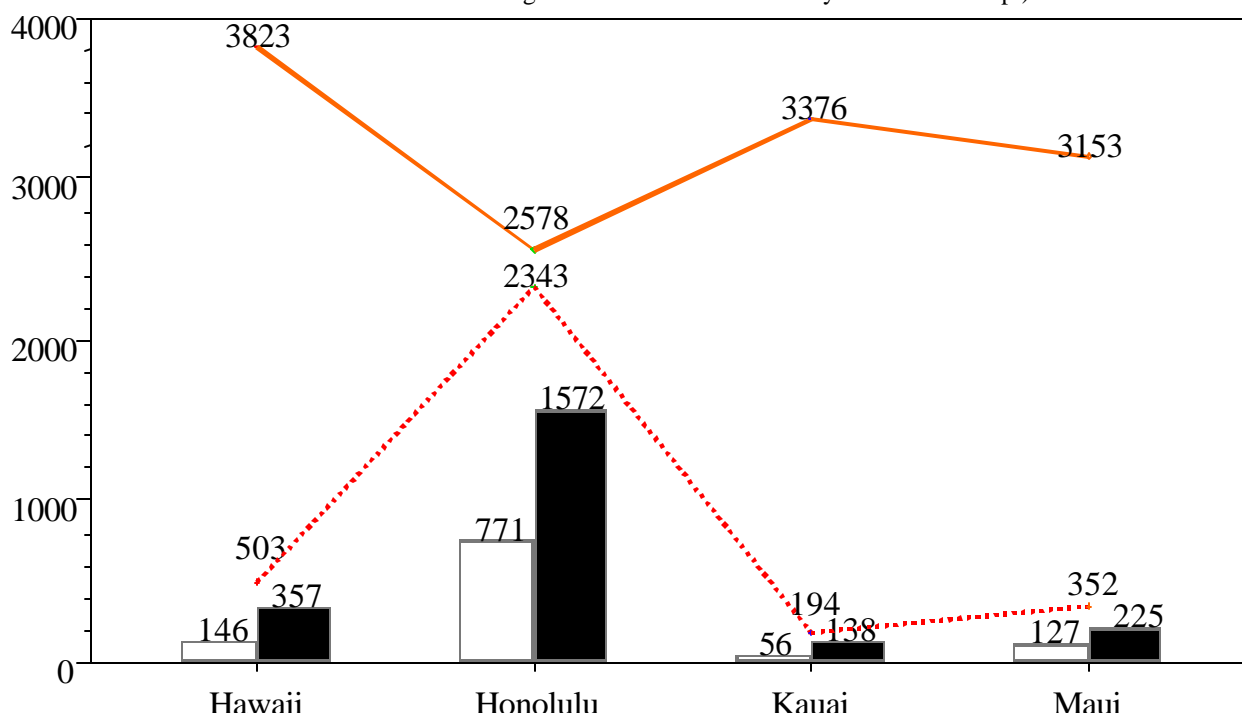
\*Also as per admissions, rates for TBI hospitalizations were much higher among males than females at every age.

\*Not included in the summary below are 53 admissions of residents of foreign countries, 211 residents of the U.S. mainland, 70 residents of Hawaii of unknown residence, and 38 other patients for whom there was no information on place of residence.

\*The proportion of male patients was fairly constant across county of residence, varying from a low of 64% for Maui county to a high of 71% for Kauai. Gender distribution was much more equal among patients who were residents of the U.S. mainland (only 57% were male).

**Number and rate\* of hospital admissions for TBI in Hawaii,  
by gender and county of residence, 1996-98.**

(White bars represent admissions among females, black bars admissions among males,  
and dotted line total for both genders. Rate is indicated by solid line on top.)

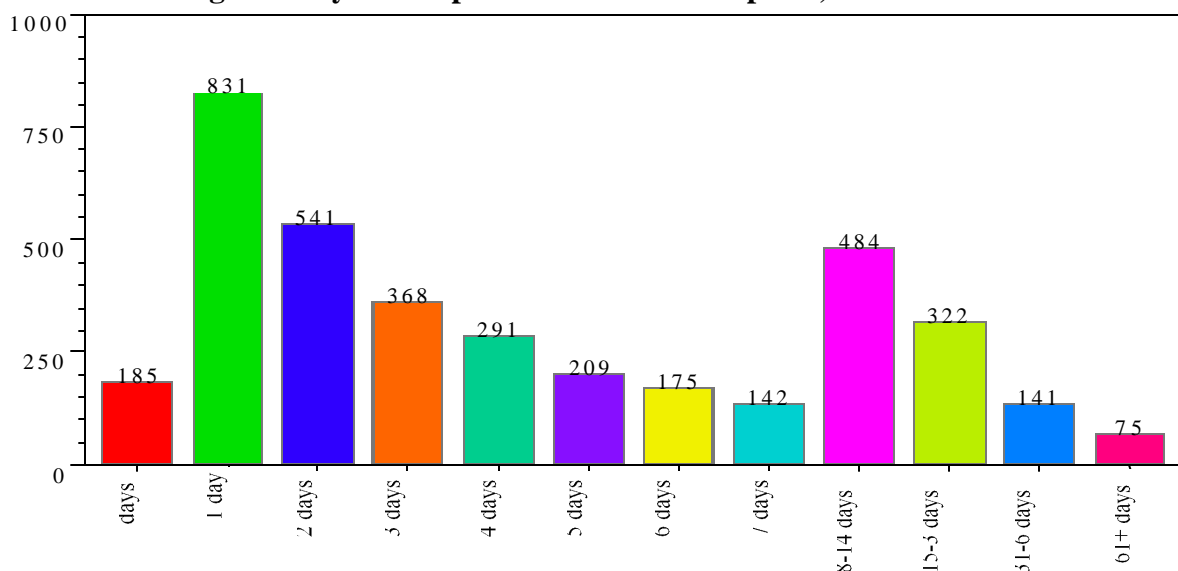


\*Rate is admissions/1 million resident population (1994 estimate), standardized across 16 age groups.

#Maui county admission include 12 from Lanai (2 females, 10 males) and 25 from Molokai (14 females, 11 males). The remaining 315 patients (111 females, 204 males) were residents of the island of Maui.

\*Although residents of Honolulu County accounted for the majority (69%) of patients, the rate of TBI was much higher in the other counties, particularly Hawaii.

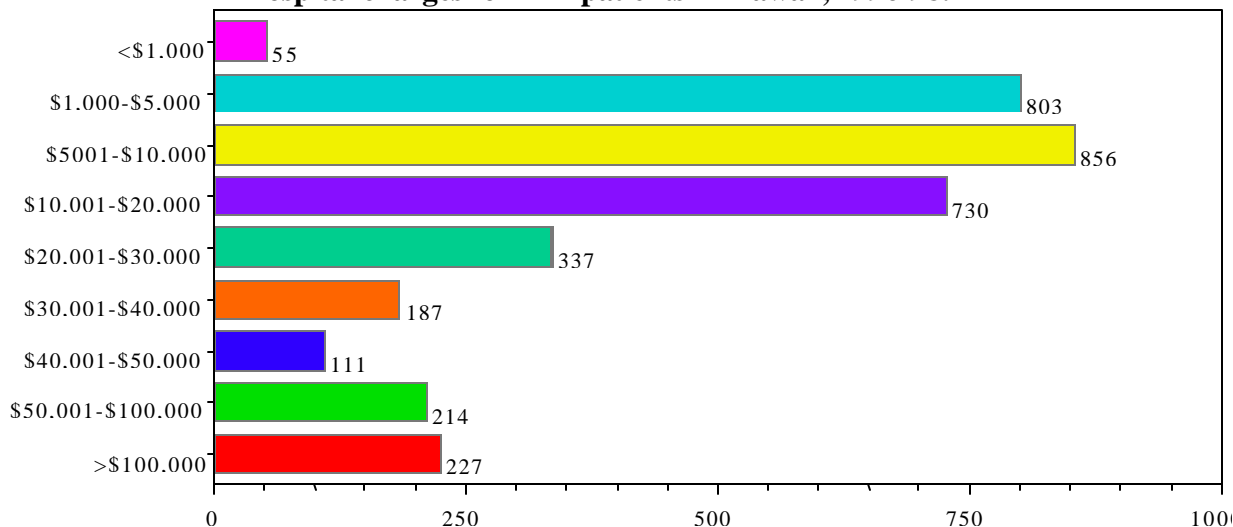
**Length of stay of TBI patients in Hawaii hospitals, 1996-98.**



\*Approximately one-quarter (1,016) of the patients were admitted for 1 day or less. Over 50% (1,925) were admitted for 3 days or less, and three-quarters (2,742) for a week or less.

\*Six percent (216) were admitted for a month or more, with 9 staying over 1 year.

**Hospital charges for TBI patients in Hawaii, 1996-98.**

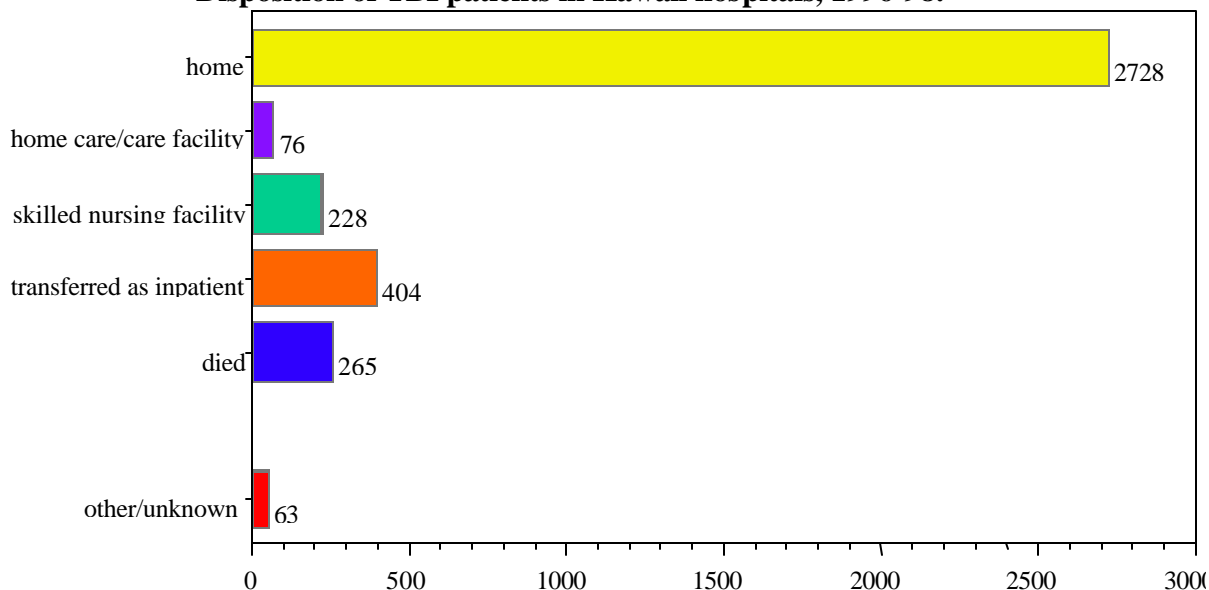


\*Total hospital charges for the 3-year period were \$107,336,524.

\*Hospital charge information was missing for 244 patients. Charges were \$10,000 or less for half (1,714) of the remaining patients, and \$50,000 or less for approximately 90% of the patients.

\*About 6% of the hospitalizations resulted in charges of over \$100,000. These 227 hospitalizations therefore account for approximately half (\$53,667,836) of the total hospital charges.

**Disposition of TBI patients in Hawaii hospitals, 1996-98.**



\*Approximately three-quarters of the patients were ultimately discharged to home (routine discharge). About 18% were discharged or transferred to another type of care facility. Seven percent died.

\*The other/unknown category includes 15 patients whose disposition was “still patient or expected to return for outpatient services”, and 43 patients who left against medical advice.

\*Multivariate analyses were conducted to determine how four main factors (age, gender, type of TBI, and county of residence) were associated with the disposition of the TBI patients. Disposition was described by three categories: 1.) discharge to home (with or without assistance), 2.) transfer to another hospital or skilled nursing facility, and 3.) death. County of residence is used as a proxy for the county in which the injury actually occurred, and does not account for the possibility of inter-hospital transfers of patients. (Two factors which this database can not characterize.)

\*The results are summarized in the following table. Not included in these analyses were the 63 patients whose disposition was listed as “other/unknown” above, and 372 for whom residence in a local county could not be established. The final sample for these analyses was therefore 3,335 patients.

\*There was a clear, significant trend between the age of the patient and the odds of death (vs. being discharged to home), even after control for the other 3 factors. In the most extreme comparison, patients who were 15 years or younger were 10 times more likely to be discharged to home (vs. dying) than those aged 76 years or older. The odds of a home discharge decreased progressively across the 4 other age groups, but was still doubled among patients 61-75 years of age, compared to those 76 years or older. There were no associations between gender and disposition.

\*Patients who were residents of Maui County had generally better dispositions than those from Oahu, but these differences disappeared after control for the type of TBI. As expected, patients who only had a concussion had the highest odds of a favorable disposition to home. There were only 5 deaths among this group.

**Prediction of discharge status of TBI patients in Hawaii, 1996-98.**

Factor	Factor level	Home discharge vs. transfer <sup>1</sup>	Home discharge vs. death <sup>2</sup>
Age	0-15 years	9.2*	10.4*
	16-30 years	4.9*	3.7*
	31-45 years	4.3*	2.7*
	46-60 years	2.0*	3.1*
	61-75 years	1.7*	1.9*
	76+ years (reference)	1.0	1.0
Gender	Female	0.9	1.1
	male (reference)	1.0	1.0
Type of TBI	concussion only	17.6*	4.1*
	skull fracture only	0.7*	1.0
	intracranial injury (reference)	1.0	1.0
County of residence	Hawaii	0.8	0.9
	Maui	1.4	1.1
	Kauai	0.8	1.3
	Honolulu (reference)	1.0	1.0

<sup>1</sup> Odds of patient being discharged to home vs. being transferred to another hospital or skilled nursing facility.

Example: patients 15 years and younger were 9.2 times more likely to be discharged home than to be transferred, compared to patients 76 years or older.

<sup>2</sup> Odds of patient being discharged to home vs. death. Example: patients 15 years and younger were 10.4 times more likely to be discharged home than to die, compared to patients 76 years or older.

\* Denotes statistically significant odds estimate ( $p < 0.05$ ).

## External causes of injuries resulting in TBI in Hawaii, 1996-98.

\*Again a **major limitation** in the Hawaii hospital discharge data is the lack of uniform E-coding, which would provide information on the cause of the injury. In particular, since the Queen's Hospital does not E-code, the following statistics can basically be thought to represent most of the TBI cases in the state that were not treated at Queen's. Only 1,572 (42%) of the hospital admissions included an E-code. More than two-thirds of the remaining 2,192 records with no E-codes are from Queen's. Therefore, if Queen's were to institute E-coding, the percent of TBI records which contain an E-code could be raised from 42% to 81%.

### Number of TBI patients in Hawaii, by category of injury, 1996-98.

Injury category	Number	Percent
Unintentional injuries		
motorcyclist	55	3
car occupant	241	15
pedestrian	50	3
bicyclist	75	5
motor vehicle crash-- unknown type	15	1
other transport	43	3
drowning/near-drowning	6	-
falls	763	49
natural/environmental	11	1
poisoning	5	-
striking	102	6
injury-other	53	3
Intentional injuries		
assaults	140	9
suicide attempt	5	-
Injuries of undetermined intent	9	-
total	1,572	

\*Approximately half of the TBI were caused by falls. No further information was available on the type of fall for 50% of these incidents. Of the remaining 385 falls, 34% were due to slipping or tripping on the same level, and each of the following categories accounted for about 8% of the total: falls from buildings or structures (29), from ladders and scaffolding (20), from stairs and steps (33),



falls from chairs (19), and falls from beds (28).

\*Injuries to motorcyclists and car occupants were all traffic-related, in that they occurred on public roads. This was also the case for most (47 of 50, or 94%) of the injuries to pedestrians. However, most of the bicycling injuries (45 of 54) did not involve motor vehicles.

\*The category of “striking” injuries mostly (92 of 102) includes being struck by or against an object or person. This includes sports injuries.

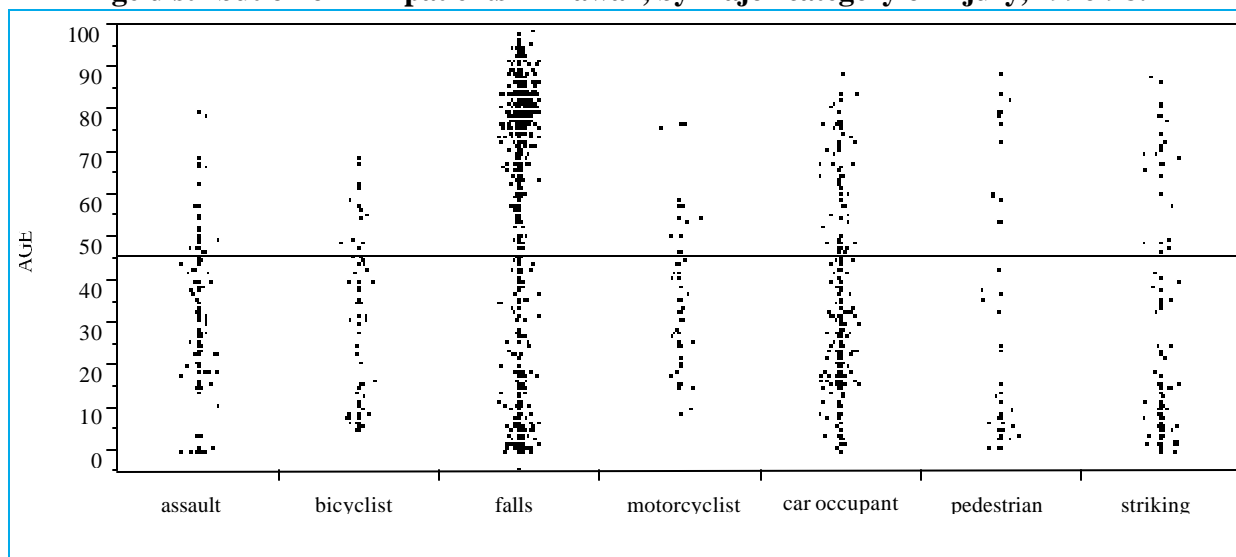
\*Assaults comprised nearly all of the 145 intentional injuries. Half (72) of these resulted from an unarmed fight or brawl. Eighteen were classified as child or adult battering, and 26 were caused by striking with an object. Only 1 was a firearm-related injury.

### **Descriptive statistics of TBI patients in Hawaii, by major category of injury, 1996-98.**

#### **1. Age:**

There was a broad distribution of age for most of the injury categories, especially for falls, car crashes, pedestrian and striking injuries (figure). There was some indication of bimodal distributions for the falls, pedestrian and striking categories; that is, there were relatively large numbers of young and old patients. Seventeen percent (132) of the patients injured by falls were between 0 and 10 years of age, and 61% (465) were 65 years or older. Forty-three percent (20) of the injured pedestrian were 0 to 10 years of age, and 9 were 75 years or older. More than half (57) of the striking injuries occurred among patients aged 0-19 years of age.

#### **Age distribution of TBI patients in Hawaii, by major category of injury, 1996-98.**



There was a smaller range of ages among victims injured in assaults, and bicycle and motorcycle crashes, with most being between the ages of 10 and 60 years. However, there were 17

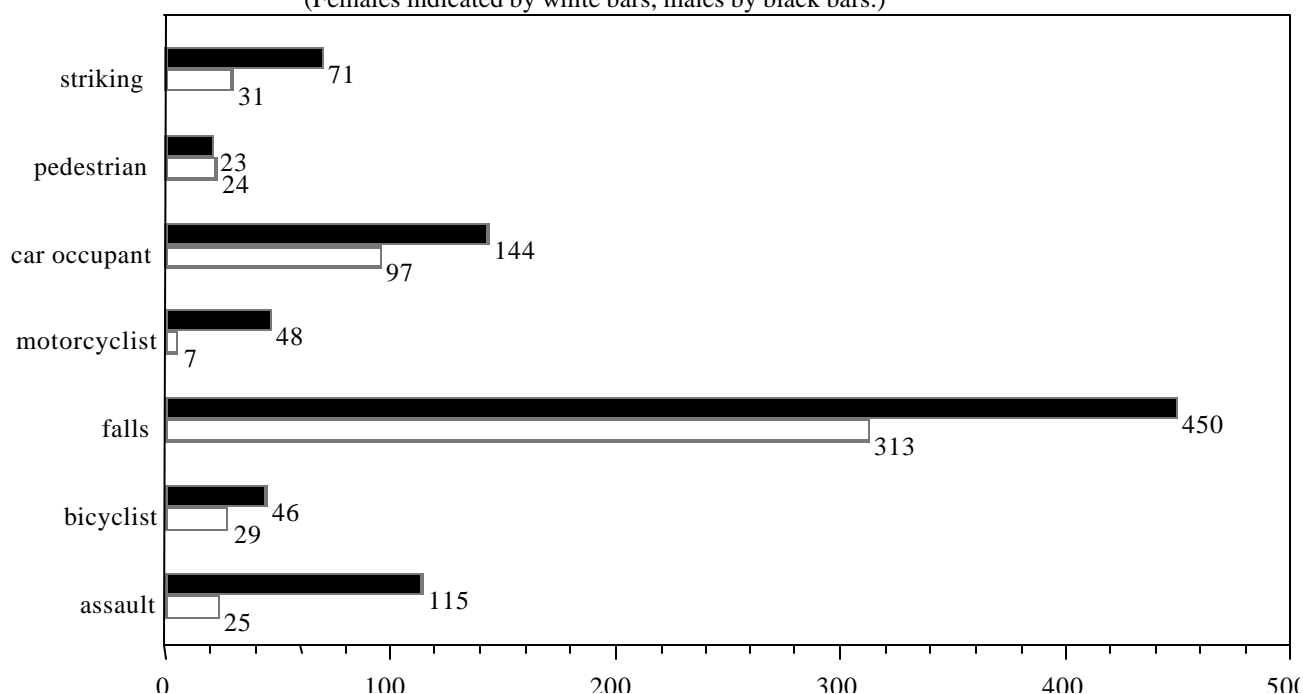
(11%) assault victims who were 0 to 4 years of age, and 27 (31%) bicyclists who were 5 to 9 years old. The ages of the car crash victims were fairly evenly distributed over a wide range, although 107 (41%) were between 15 and 30 years of age.

## 2. Gender:

Approximately two-thirds (897 of 1,423) of these victims were male. This proportion varied by injury category, however (figure). All but 7 of the motorcyclists were males, and 115 (82%) of the assault victims were males. The distribution of gender was more equal among the other categories, particularly pedestrian and car crashes, and injuries from falls.

**Number of TBI patients in Hawaii, by gender and major category of injury, 1996-98.**

(Females indicated by white bars, males by black bars.)



## 3. Geographic residence:

It is hard to interpret the summary of the geographic residence of TBI patients given below, as this may be biased by Oahu hospitals which do not E-code.

**Number of TBI patients in Hawaii, by county of residence and category of injury, 1996-98.**

